Bridge Load Rating & Evaluation
Engineering Services - S-239-19

SCDOT

Technical Note
e-Notification
No. 02
August 30, 2019

Technical Note 02

1. Rating Standard Precast Slab Bridges:

SCDOT has many standard H10, H15, and HS20 precast slab bridges. They consist of 15' long precast concrete panels post-tensioned together at the ends with 5'-6" wide interior units and 2'-9" or 5'-6" wide exterior units.

For this contract, all standard precast slab bridges shall be modeled and rated in BrR using a *Reinforced Concrete Slab System Superstructure* definition, with each individual slab strip width input to match the precast units as shown in the standard drawings. See a sample BrR Structure Typical Section in ***Figure 1*** below.

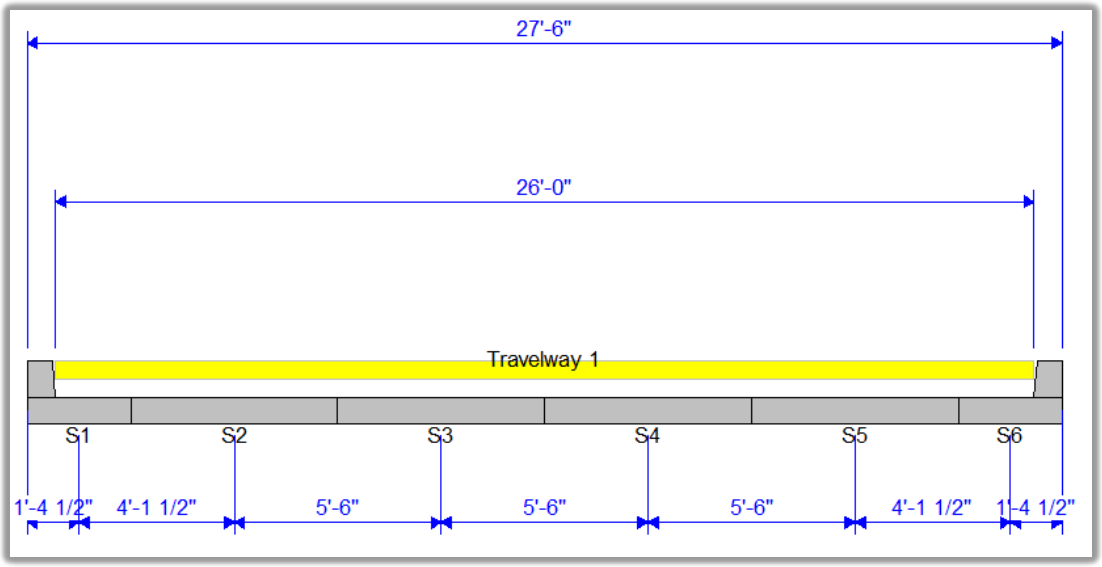

Figure 1 – Sample BrR Structure Typical Section (H10 – 26')

For load rating, assume the transverse ties are ineffective in distributing load transversely between slab units. Each unit behaves independently under dead and live load.

Superimposed dead loads (curbs, guardrail, parapets, etc.) shall be applied to the tributary slab unit carrying the load (typically the exterior slab).

Live load distribution factors shall be computed by the lever rule. Live load on the exterior slab units shall be determined in accordance with AASHTO LRFD Section 3.6.1.3.1. Generally, the 2'-9" exterior slab units are cast with a 9" curb and therefore the edge wheel line is not supported by the slab. The 5'-6" exterior slabs can generally accommodate a single edge wheel line.

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LLDFs

Interior Slab units:	2'-9" Exterior Slab units	5'-6" Exterior Slab units
LRFR = 0.6 lanes[2]	LRFR = 0.0 lanes[1]	LRFR = 0.6 lanes[2]
LFR = 1.0 wheels	LFR = 0.0 wheels[1]	LFR = 1.0 wheels
See **Figure 2**	See **Figure 3**	See **Figure 4**

Note 1: to prevent run-time errors in BrR, input a LLDF of 0.001 (LFR and LRFR) for the exterior units which do not carry live load

Note 2: LRFR single lane DF shall include the AASHTO LRFD Multiple Presence Factor from Table 3.6.1.1.2-1

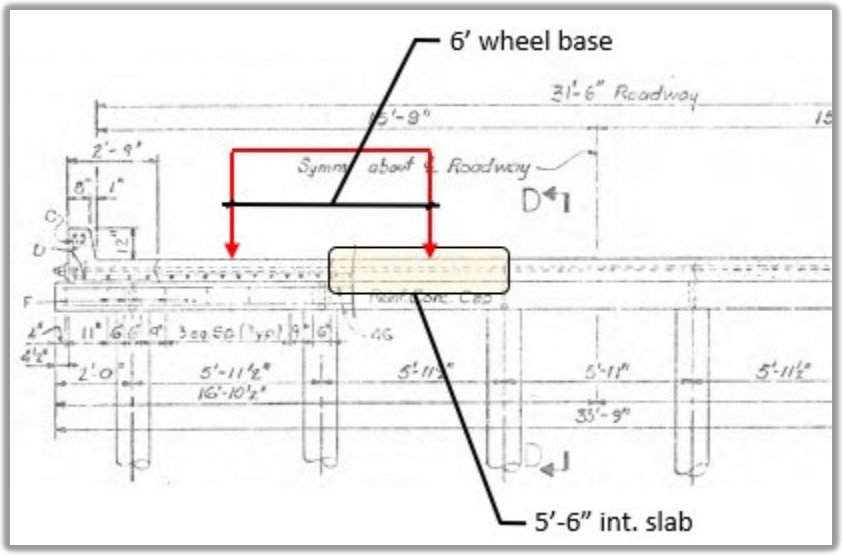

Figure 2 – 5'-6" Interior Slab

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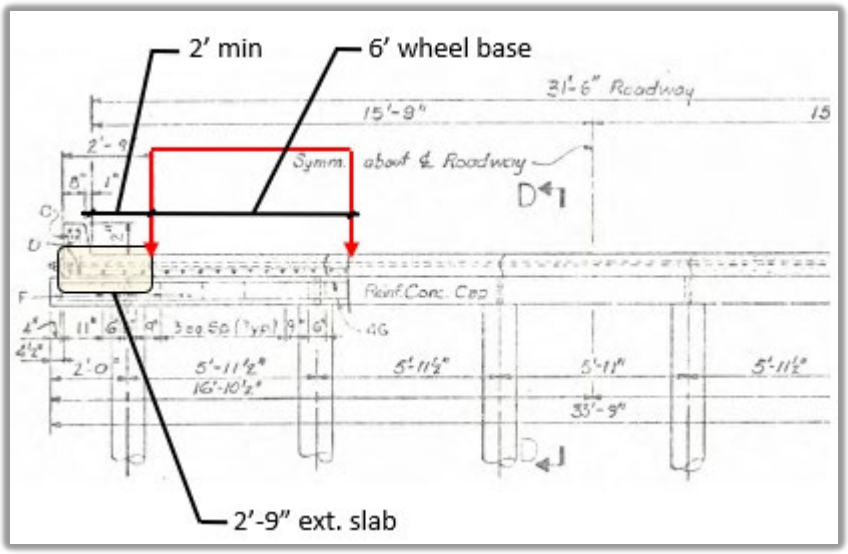

Figure 3 – 2’-9” Exterior Slab

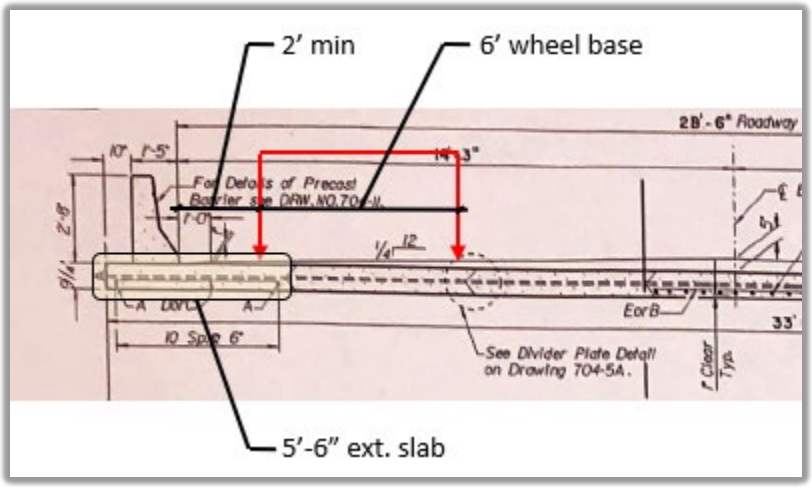

Figure 4 – 5’-6” Exterior Slab LLDF

2. <u>Superimposed Dead Load Distribution</u>

Question:

As per the SCDOT Load Rating Guidance Document (LRGD), superimposed dead load (SDL) shall be distributed as per the SCDOT Bridge Design Manual (BDM).

BDM 13.2.3 states that all SDL is to be evenly distributed for cross sections with 6 girders or less. For sections with more than 6 girders, the SDL on each side of the section is distributed only to the exterior 3 girders on that side of the cross section.

If there is a longitudinal joint in the median (and no diaphragms in the bay under the median), then the portion of the median on each side of the longitudinal joint would be considered as the exterior SDL for that cross section of deck, and distributed as described above. If there is no longitudinal joint in the median, the BDM does not discuss SDL distribution for the median. Using the same logic as that provided for the exterior SDL (sidewalk etc.) would imply that median SDL should also be distributed to multiple girders under and near the median. Therefore, we would interpret that intent as follows:

1. For a median centered over a girder, median SDL should be distributed to that girder and the two girders on either side (3 girders total).

2. For a median over a girder bay between 2 girders, median SDL should be distributed to the two girders on either side of the bay and one girder adjacent to each side of that bay (4 girders total).

Answer:

We agree with this approach, as we have illustrated in Figure 3 of the simple sketch below:

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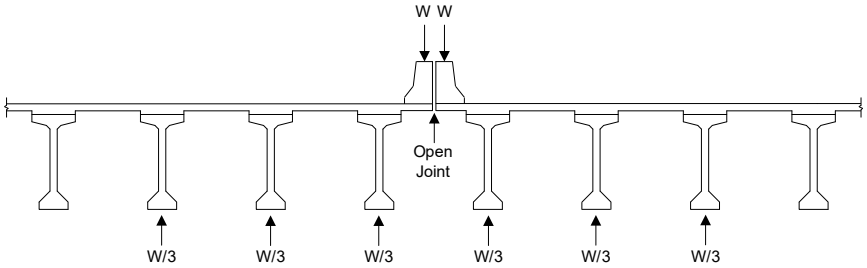

Figure 1

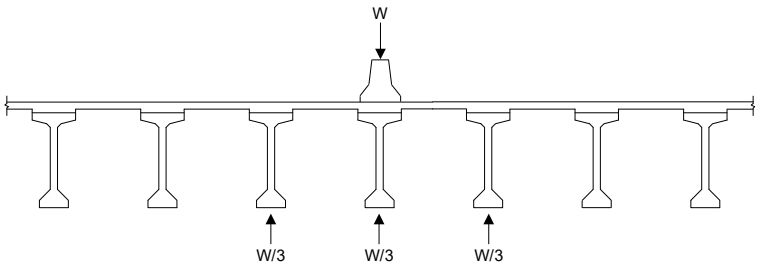

Figure 2

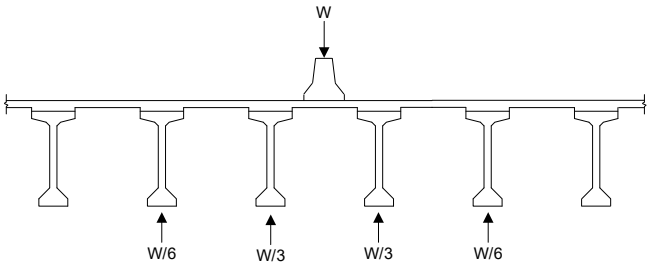

Figure 3

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3. Stay-In-Place Forms Dead Load

Question:

SIP Forms DL:

The SCDOT Bridge Design Manual (BDM) says to use 16 psf to account for the weight of the concrete in the flutes of the Stay-In-Place (SIP) forms. This is covered in BDM 13.2.2 shown below. This weight is equivalent to 1.25" additional thickness of concrete slab, which implies that the design slab starts from the top of the metal form (usually 2 to 2.5" deep, with approx. half that thickness say 1.25" representing the weight of the concrete in the flutes).

> **13.2.2 Deck Slab Dead Load**
>
> Reference: LRFD Article 9.7.4
>
> Bridge dead load (DL) consists of composite and non-composite components.
>
> Loads applied to the non-composite cross section (i.e., the girder alone) include the weight of the plastic concrete, forms, and other construction loads typically required to place the deck. Calculate the non-composite DL using the full slab volume including haunch volumes times the unit weight of concrete. Because steel stay-in-place formwork is typically used by contractors in South Carolina, an additional 0.016 k/ft^2 is applied between the girder flanges to account for the concrete in the flutes of the formwork. Use the weight of the slab and formwork plus 0.05 k/ft^2 to account for construction loads to check deflections and stresses and to assess girder stability prior to the hardening of the concrete.

However, if the plans show that the bottom of the deck lines up with the mid-depth of the form instead of the top of the form, it is our opinion that 16 psf would be too conservative to add to the structure for load rating. Also, the actual weight of the sheet metal forms is generally minimal and is generally offset by the trough of the form being slightly smaller than the peak resulting in more cross-section removed above the mid-depth than added below.

In this case, it does not seem appropriate to add any additional dead load.

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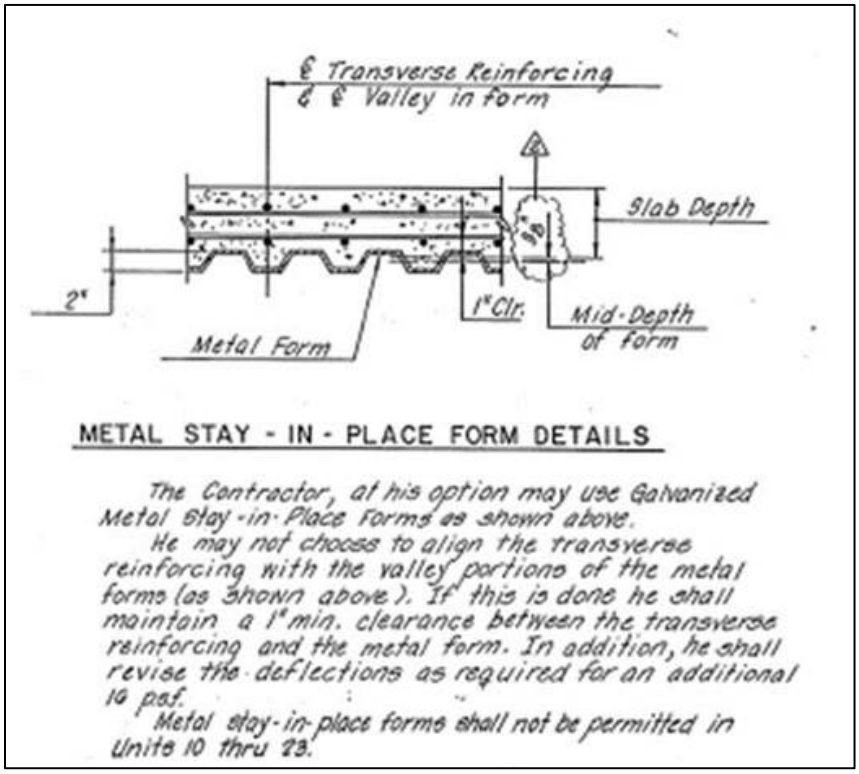
Answer:

Conservatively use the 16 psf for all bridges with SIPs. If the bridge requires posting, consider removing the SIP load if the shop drawings and Site Assessment (SA) clearly indicate that the SIP load is smaller than 16 psf. If this approach is utilized, also confirm the deck thickness shown on the plans is accurate.

Follow-Up Question:

Typically shop drawings only show steel superstructure so there will not be any details of the deck/SIP forms on shop drawings. As far as the SA, the deck thickness in inner bays with SIP forms is not one of the items routinely measured. So, the design plan details of the deck design thickness relative to the SIP forms (such as shown below) is the only information that can be used to make modifications to the load in case the bridge requires posting. Also, in most cases, the SA will be completed by the time final rating results are received. So, in a case like shown below, if the bridge needs posting, the SIP weight would be changed to the weight of 3/8" additional thickness of deck (5 psf). If the detail shows the bottom of the slab at the mid depth, then the SIP weight would be zero.



METAL STAY - IN - PLACE FORM DETAILS

The Contractor, at his option may use Galvanized Metal Stay-in-Place Forms as shown above.
He may not choose to align the transverse reinforcing with the valley portions of the metal forms (as shown above). If this is done he shall maintain a 1" min. clearance between the transverse reinforcing and the metal form. In addition, he shall revise the deflections as required for an additional 10 psf.
Metal stay-in-place forms shall not be permitted in Units 10 thru 23.

Please verify that the above approach using design plan details is reasonable in case the standard 16 psf results in a need for posting.

Answer:

The SIP detail shown above mentions another option for the Contractor to use for installation of the SIP forms. As you mentioned, this will be difficult to confirm in the field. To be conservative and follow the plan note and LRGD use 16 psf for the weight of the additional concrete in the SIP forms and use deck thickness shown on the plans. If a bridge requires posting and during the posting avoidance process it is determined that removing the 16 psf increases the ratings enough to eliminate the need for posting, this can be submitted as a BMO posting avoidance request for approval. Please note justification will need to be provided to document removing the 16 psf load is warranted (i.e. something was observed in the field to confirm the method the Contractor used to place the SIPs).

4. SDL for Light Poles/Sign Posts

Question:

SDL for light poles/sign posts:

The Load for Light Poles / Sign Posts is to be treated like any other Superimposed Dead Load (SDL), i.e. apply point load DC2 evenly distributed to all beams at the light pole / sign post location (if < 7 beams) and only to first 3 beams (if 7 or more beams).

Please confirm this approach is the proper interpretation of the SCDOT Bridge Design Manual (BDM) to be used for the rating.

Answer:

Correct. Treat the Light Pole / Sign Posts load like any other SDL. Evenly distribute the point load to the nearest three girders.

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5. AASHTOWare BrR "Permit Load Tensile Stress" Setting for Prestress I-Beam Girder Systems

Question:

Using the standard defaults for AASHTOWare BrR result in a check mark in the box for "Consider Permit Load Tensile Stress" for Prestressed I-Beam Girder Systems, which does not match the Load Rating Guidance Document (LRGD) (box is unchecked). Please confirm that the intent is to not consider permit load tensile stress (as per LRGD).

Answer:

Page 14 of 15 of the "SCDOT LR BrR Defaults Import Instructions_2019-07-15.pdf", LRGD Figure 9.2.1.2-2 (and Figure 10.2.1.2-2) shows the "Consider permit load tensile steel stress" box unchecked. However, LRGD Section 10.2.3 states "The Service III check for legal loads and the Service I check for permit loads shall be performed." Therefore, this box is CHECKED in the SCDOT LR BrR Defaults template. Permit load tensile stress should be considered for Prestressed I-Girder Beam Systems.

6. Clarification That Skewed Culvert Edge Beams Do Not Need Rated

Question:

Load Rating Guidance Document (LRGD) 17.2.2.2 item 3 states: On skewed culverts, do not rate edge beams.

It does not discuss edge beams for non-skewed culverts. However, it makes sense that edge beams for non-skewed culverts should also not be rated. Please confirm that the intent is to not rate edge beams for all culverts (skewed or non-skewed).

Answer:

Correct. Edge beams of culverts, skewed or non-skewed, do not have to be rated.

Please direct any questions concerning the above to:

Michael Baker International
e-mail: SCDOT_LR_Help_Desk@listserv.bakerprojects.com